Wisconsin Electric Power Company
Docket 5-ES-111
Strategic Energy Assessment (SEA) for the Years
January 1, 2022 through December 31, 2028
Supplemental Data Request – Martin Day - 11122021

REQUEST: *Utility Resource Planning*

At its Open Meeting of September 2, 2021, as part of its discussion of the Roadmap to Zero Carbon investigation in docket 5-EI-158, the Commission directed staff to collect more information on utility resource planning and decisions as part of SEA 2028. This additional information will make the SEA more comprehensive and improve public understanding of the rationale and effects of utilities' planned resource decisions.

Providers must submit (as one or more documents) the following information:

1. A narrative description of the driving factors behind additions and retirements, including an explanation of the rationales for each retirement, and the role of new generation additions, as well as other considerations such as forecasted customer demand, in ensuring the utility meets future capacity and generation needs. This narrative should also explain the influence of utilities' carbon reduction goals on their decisions.
2. An explanation of the analysis procedures used by the utility to determine addition and retirement decisions, including the analytical models used, the rationale for selection of those models, and the methods used by the utility to ensure accurate and reliable modeling results;
3. A description of the goals and standards used by the utility to set initial parameters for modeling, which may include but should not be limited to its definition of standards for maintaining system reliability, required reserve margins for resource adequacy, and the application of utility carbon reduction goals.
4. Specification of the key input assumptions used to model system and market conditions, as well as any alternative assumptions used to conduct sensitivity analysis on the effects of different generation alternatives.
    a. This specification shall include a detailed description of how the provider accounts for any existing renewable energy offerings, including but not limited to community solar and renewable energy riders.
5. Specific description of all generation scenarios considered in analysis.

A presentation of modeling results that explains how the utility selected the proposed generation scenario reflected in its reported additions and retirements, and how the utility concluded this scenario was superior to other scenarios considered.

Response:

1. Please see CONFIDENTIAL Attachment A
2. Please see CONFIDENTIAL Attachment B, pages 1-4
3. Please see CONFIDENTIAL Attachment A
4. Please see CONFIDENTIAL Attachment B, pages 4-12
   a. In December 2018 Wisconsin Electric received approval for two innovative renewable energy pilot programs. The Solar Now pilot program allows Wisconsin Electric to install up to 35MW of solar generation on land or building roof space made available by participating hosts. Non-profit and government entities and commercial and industrial customers are eligible to participate in the program. Wisconsin Electric constructs, owns, operates, and maintains the facilities and makes lease payments to hosts based on the size of the projects installed at their sites. Each host may also elect to purchase the Renewable Energy Credits generated by the project located on their site. Size of individual projects are capped at the lesser of 2.25MW and the firm load of the host. All of Wisconsin Electric customers receive the benefits and incur the costs of the program. The Dedicated Renewable Energy Resource pilot allows Wisconsin Electric to install up to 150MW of wind or solar generation in Wisconsin which may be located at one or more sites. A customer may choose to participate in the program up to the amount of their firm load. Participating customers receive all the benefits and incur all the costs for their pro rata portion of the project(s).
5. Please see CONFIDENTIAL Attachment B, pages 13-18

Response by: Brandon Gerlikowski

ATTACHMENT A - Supporting Need Case

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Request: Utility Resources Planning

WEC Energy Group ("WEC") has long been a leader in providing safe, reliable energy to Wisconsin customers. Since 2005, We Energies has been recognized thirteen times as the most reliable utility in the Midwest, including every year for the past decade.

Over the same period, WEC has prioritized clean energy. By converting the Valley Power Plant to clean natural gas, installing Wisconsin's largest wind energy facilities, constructing the first utility-scale solar fields in the State of Wisconsin, retiring multiple coal plants, and exceeding its 2030 carbon reduction goal over ten years ahead of schedule, WEC has consistently demonstrated that providing safe, reliable energy need not come at the expense of the environment. By leveraging technological advancements in power generation, preserving reliability, promoting fuel diversity, and advancing sustainability can go hand in hand.

Now, as we enter a new decade, WEC is once again leading by developing a clean energy blueprint to achieve its more aggressive goal of reducing its carbon emissions **70% by 2030** relative to 2005 levels[1]. As shown in the pie charts below, WEC's generation fleet will be transformed to further transition Wisconsin to a cleaner and lower cost energy future without sacrificing safety or reliability.

[1] Since the evaluation was completed WEC has updated its CO2 reduction targets to 60% by 2025 and 80% by 2030

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Figure 1 –WEC Capacity by technology - 2020

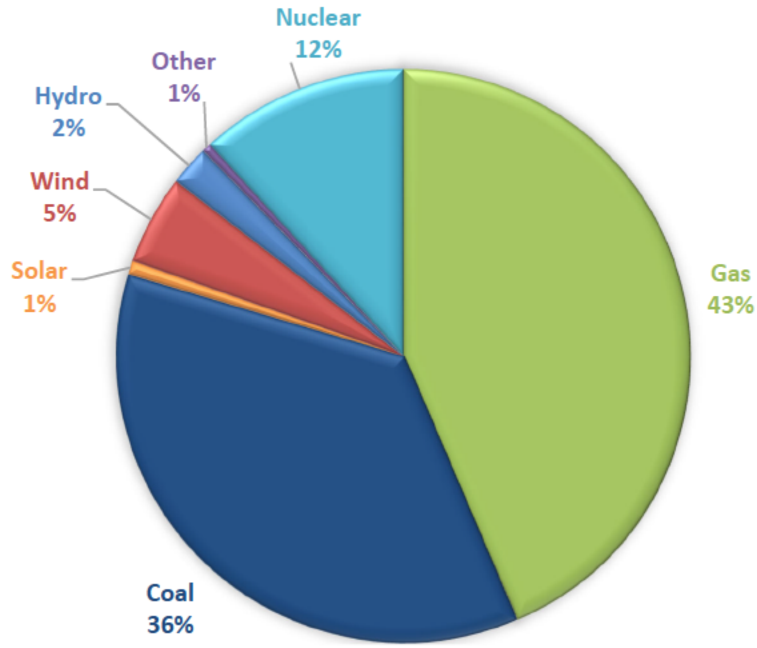
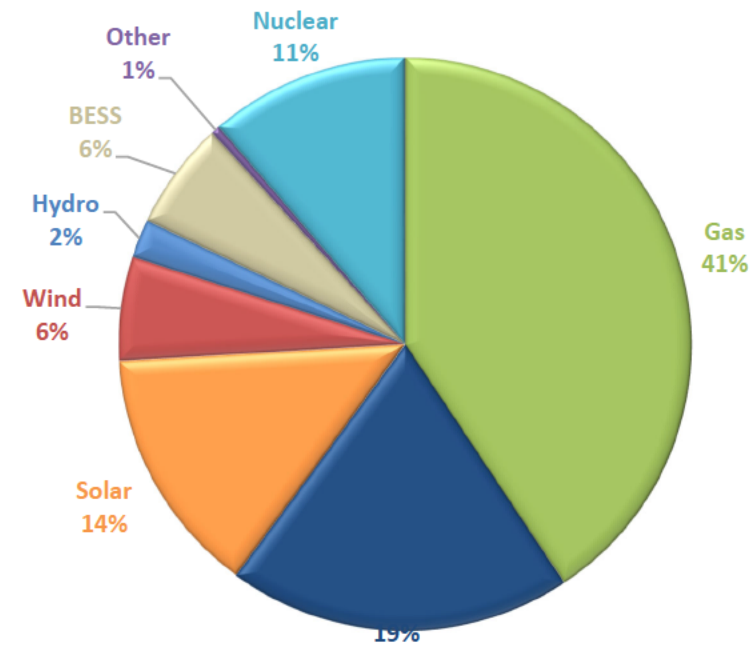


Figure 2 – Projected WEC Capacity by technology - 2025



WEC's Generation Reshaping Plan: Objectives

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The objectives of WEC's Generation Reshaping Plan are to maintain safety and reliability at Wisconsin Electric Power Company ("WEPCO") and Wisconsin Public Service Corporation ("WPSC") while prudently investing in a transition to a cleaner, greener combined generation portfolio in a way that provides both economic and environmental value to customers. The plan balances the following five key objectives:

- ✓ ***Environmental Impact:*** Achieving 70% carbon reduction goal by 2030 (and net carbon neutrality by 2050) by investing in new Wisconsin-based renewable resources and expanding the existing clean energy portfolio including innovative storage technologies.

- ✓ ***Economic Value*****:** Harnessing market forces driving cost-competitive renewable and storage technology and maximizing efficiencies within WEC's own fleet, to the ultimate benefit of customers.

- ✓ ***Reliability*****:** Continuing to design, operate, and maintain state-of-the-art generation resources to provide a safe reliable, and stable flow of electricity to serve the demand of Wisconsin homes and businesses.

- ✓ ***Resiliency:*** Maintain and improve a diverse generation portfolio to prepare for, withstand, and recover from significant disruptions.

- ✓ ***Market Risk:*** Recognizing that as technological advancements expand, geographic proximity of a generating fleet's assets to the customers it serves remains critical to ensuring that Wisconsin customers can depend on Wisconsin resources for their energy needs.

Generation Reshaping Plan: Need

WEC plans to retire approximately 1,800 MW of older, less efficient fossil fuel generation within the next few years. The units identified for potential retirement are aging and in some cases have reached the end of their estimated useful lives. To continue operating, the older and less efficient units slated for potential retirement would require extensive future capital spending including potentially significant environmental compliance investments. In addition, these units have significant annual operating and maintenance costs, which are expected to challenge their economic viability in the future. In the case of older combustion turbines, the units are obsolete and simply cannot be reliably maintained due to lack of available replacement parts. In addition, the Whitewater lease with WEPCO expires in 2022.

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Figure 3: Proposed Retirements

Generating Units	Technology	Utility	Capacity		Retirement Date*
			ICAP	UCAP	
Oak Creek 5	Coal	WEPCO	236	180	5/31/2023
Oak Creek 6	Coal	WEPCO	248	203	5/31/2023
Oak Creek 7	Coal	WEPCO	298	269	5/31/2024
Oak Creek 8	Coal	WEPCO	303	262	5/31/2024
Columbia 1	Coal	WPS	156	150	11/1/2023
Columbia 2	Coal	WPS	155	150	11/1/2024
Weston 2	Gas (steam)	WPS	75	71	5/31/2023
Weston 31	Gas (CT)	WPS	18	17	5/31/2023
Weston 32	Gas (CT)	WPS	50	40	5/31/2023
Marinette 31	Gas (CT)	WPS	38	33	5/31/2023
Marinette 32	Gas (CT)	WPS	36	32	5/31/2023
Whitewater	CC (PPA)	WEPCO	238	224	5/31/2022
WEPCO Total			**1,323**	**1,138**	
WPS Total			**528**	**494**	
Combined Total			**1,851**	**1,631**	

To manage market risk and reliably serve their customers, WEPCO and WPSC will need to build a substantial amount of replacement generating capacity over the next several years. The following tables identify the forecasted MISO capacity position for each company after accounting for the retirements identified in the table above, over the next 15 MISO planning years. WEC's Generation Reshaping Plan will address these capacity shortfalls.

Figure 4: WEPCO – MISO Capacity Positions for PY 2021 through PY 2035[2]

MISO (UCAP)	*PY21*	*PY22*	*PY23*	*PY24*	*PY25*	*PY26*	*PY27*	*PY28*	*PY29*	*PY30*	*PY31*	*PY32*	*PY33*	*PY34*	*PY35*
Total Firm Demand	[redacted]														
Reserve Margin															
Total Obligation															
Total Existing Capacity															
Capacity Position (PRA)															
Reserve Margin															

[2] All future values are estimates based on reasonable but uncertain assumptions. PY21 determinants, e.g. Transmission Loss %, etc... are carried forward. The calculated net position is shown as a discreet value but is understood to be a range which includes the annual value shown as load and supply, forced outage factors, Transmission Loss %, Reserve Margin %, etc... Uncertainties can be additive in either direction.

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Figure 5: WPSC – MISO Capacity Positions for PY 2021 through PY 2035[1]

MISO (UCAP)	[redacted]
Total Firm Demand	
Reserve Margin	
Total Obligation	
Total Existing Capacity	
Capacity Position (PRA)	
Reserve Margin	

Replacement Generation

To address these substantial capacity needs, WEC has developed a diverse portfolio of generation projects that meet the Generation Reshaping Plan's interrelated goals of: (1) delivering positive economic impact; (2) providing value to customers; (3) ensuring system reliability; (4) providing resiliency; and (5) hedging against market risks.

Figure 6: Portfolio of Replacement Generation

TECHNOLOGY	UTILITY	CAPACITY		IN-SERVICE
		ICAP	UCAP	
SOLAR	WEPCO	788	551	2023/2024
	WPS	158	110	2023/2024
BESS	WEPCO	451	442	2023/2024
	WPS	107	105	2023/2024
WIND	WEPCO	n/a	n/a	n/a
	WPS	82	13	2022
GAS (RICE)	WEPCO	64	61	2023
	WPS	64	61	2023
GAS (RIVERSIDE)	WEPCO	200	190	2023/2024
	WPS	n/a	n/a	n/a
TOTAL	**WEPCO**	**1,503**	**1,244**	**2023/2024**
	WPS	**412**	**289**	**2022/2024**
	COMBINED	**1,915**	**1,533**	**2023/2024**

The resulting capacity position with the addition of the replacement generation identified in the table above will be as follows for each company:

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Figure 7: WEPCO – Capacity Position after Replacement Generation[3]

MISO UCAP Position	***PY21***	***PY22***	***PY23***	***PY24***	***PY25***	***PY26***	***PY27***	***PY28***	***PY29***	***PY30***	***PY31***	***PY32***	***PY33***	***PY34***	***PY35***
Coincident Peak Demand	[redacted]														
Reserve Requirement	[redacted]														
Total MISO Obligation	[redacted]														
Capacity Resources:	[redacted]														
Existing Capacity	[redacted]														
Riverside	[redacted]														
Weston RICE	[redacted]														
Battery 1	[redacted]														
Battery 2	[redacted]														
Paris Solar	[redacted]														
Paris BESS	[redacted]														
Darien Solar	[redacted]														
Darien BESS	[redacted]														
Koshkonong Solar	[redacted]														
Koshkonong BESS	[redacted]														
Solar 6	[redacted]														
Battery 6	[redacted]														
Total Capacity	[redacted]														
Capacity Position	[redacted]														
Reserve Margin	[redacted]														

Figure 8: WPSC – Capacity Position after Replacement Generation[2]

MISO UCAP Position	***PY21***	***PY22***	***PY23***	***PY24***	***PY25***	***PY26***	***PY27***	***PY28***	***PY29***	***PY30***	***PY31***	***PY32***	***PY33***	***PY34***	***PY35***
Coincident Peak Demand	[redacted]														
Reserve Requirement	[redacted]														
Total MISO Obligation	[redacted]														
Capacity Resources:	[redacted]														
Existing Capacity	[redacted]														
Weston RICE	[redacted]														
Battery 1	[redacted]														
Battery 2	[redacted]														
Paris Solar	[redacted]														
Paris BESS	[redacted]														
Darien Solar	[redacted]														
Darien BESS	[redacted]														
Koshkonong Solar	[redacted]														
Koshkonong BESS	[redacted]														
Solar 6	[redacted]														
Battery 6	[redacted]														
Total Capacity	[redacted]														
Capacity Position	[redacted]														
Reserve Margin	[redacted]														

[3] All future values are estimates based on reasonable but uncertain assumptions. PY21 determinants, e.g. Transmission Loss %, etc... are carried forward. The calculated net position is shown as a discreet value but is understood to be a range which includes the annual value shown as load and supply, forced outage factors, Transmission Loss %, Reserve Margin %, etc... uncertainties can be additive in either direction.

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WEC's Generation Reshaping Plan will transition its fleet to a clean, reliable future by retiring some of its older, less efficient fossil fuel plants, investing in low-cost renewable and storage resources in Wisconsin, and creating energy solutions to meet the needs of the customers and communities WEC serves. The material below describes how the Generation Reshaping Plan accomplishes each of its five objectives.

While WEC's efforts to date have already achieved strong results – including meeting its original 2030 carbon reduction goal over a decade ahead of plan – in 2019 – additional generation reshaping is required to meet a more aggressive target of a 70% carbon reduction by 2030. At a high level, over the next five years, these efforts will include:

- ✓ Identifying plant retirements based on unit age, efficiency, and potential for customer savings.
- ✓ Developing new utility-scale zero carbon resources in Wisconsin.
- ✓ Adding resources that will maintain and enhance system reliability.
- ✓ Quantifying customer benefits and progress toward WEC's 80% carbon reduction goal.

On the path to its 80% carbon reduction goal, WEC anticipates retiring older, less efficient fossil generation, with a particular focus on its coal fleet. Between extensive future capital and operations and maintenance requirements and significant future environmental compliance requirements, these units are ripe for re-evaluation, and the savings generated by WEC's Generation Reshaping Plan—nearly **$1 billion over 20 years**[4], compared to the status quo—will contribute to WEC's investment in clean, renewable resources in Wisconsin.

These new resources will include traditional zero-carbon and zero-fuel cost resources, including Wisconsin-based utility-scale solar and wind; highly efficient and dispatchable natural gas

[4] See supporting analysis in confidential Appendix B to this application.

generation technology to balance energy production changes caused by the intermittent nature of renewable resources and storage at utility-owned renewable projects.

Accomplishing all of this requires thoughtful planning and a comprehensive approach. Each of the individual projects that make up WEC's overall Generation Reshaping Plan were selected to support the balance of resources and objectives discussed above.

Portfolio – Environmental Impact

As noted above, WEC's goal is to reduce carbon emissions by 70% by 2030. In order to meet this goal, replacing older, less efficient fossil generation capacity with new capacity consisting of renewable and storage technology is required.

Portfolio - Economics

To retire coal generation nearing the end of useful life, significant generation supply resources will be required in the future in order to minimize the capacity short or long position and financial risk to the utilities' customers.

Technology advancements in renewables and storage have lowered their costs and increased their efficiency, making them cost-effective compared to traditional electric generation resources. Increasing renewables and storage technology to create an optimal generation resource mix will enable WEC to reshape its portfolio, while maintaining high levels of reliability and creating significant customer savings over the course of the next 20 years.

The cost of new wind, solar, and storage technologies continue to decline relative to traditional fossil fuel and nuclear generation technologies. In the October 2020 Lazard Levelized Cost of Energy ("LCOE") analysis, the three lowest-cost unsubsidized new resources were utility scale solar, wind, and natural gas combined cycle generation. In fact, the latest Lazard analysis shows that the LCOE of new renewable resources is becoming competitive with the marginal operating cost of *existing* fossil fuel and nuclear generation units.

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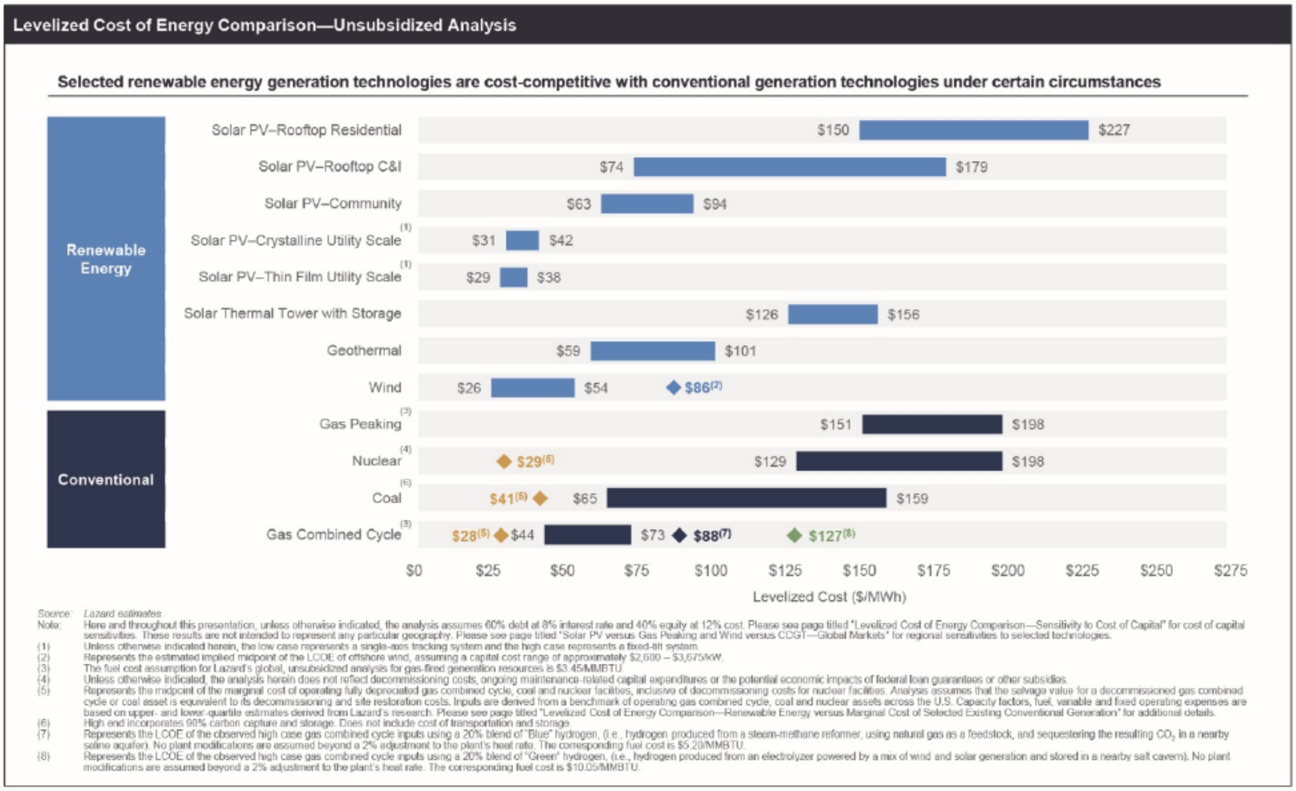
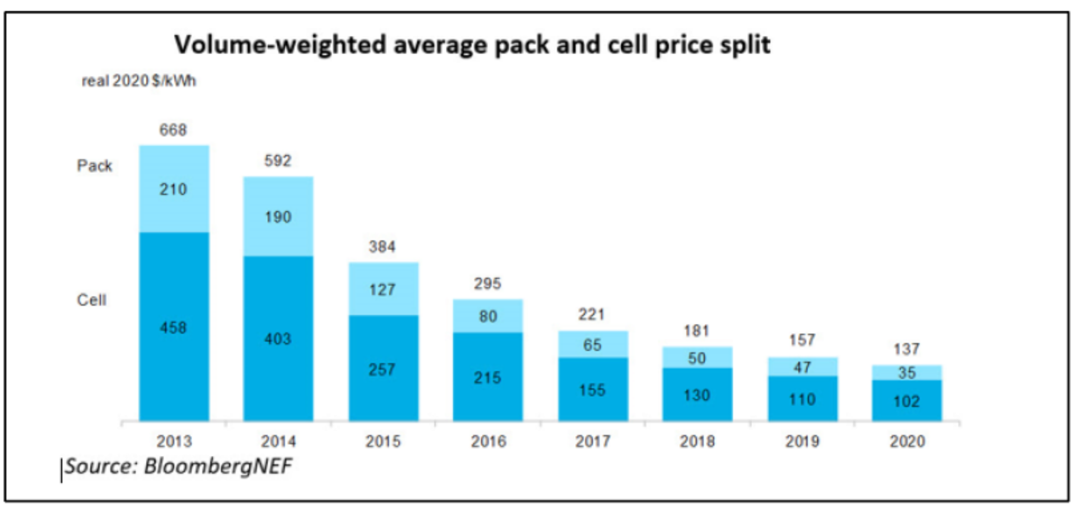
Figure 9: 2020 LCOE for Generation Resources



Battery storage costs also continue to decline, with prices down 13% over just the last year, according to BloombergNEF's annual battery price survey.

Figure 10: Battery Price – 2013-2020



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In addition to declining technology costs, the current tax credit environment also contributes to the cost-competitiveness of renewable resources. Under current law, Investment Tax Credits and Production Tax Credits are slated to phase down or completely phase out over time.

Figure 11: Availability of PTC and ITC

		Commercial Operation Date										
	Start of Construction	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026 or Later
Wind (PTC)	2016 or Earlier	100%	100%	100%	100%	100%	100%					
	2017		80%	80%	80%	80%	80%	80%				
	2018			60%	60%	60%	60%	60%				
	2019				40%	40%	40%	40%	40%			
	2020					60%	60%	60%	60%	60%		
	2021						60%	60%	60%	60%	60%	
	2022 or Later											
Solar (ITC)	2019 or Earlier	30%	30%	30%	30%	30%	30%	30%	30%	10%	10%	10%
	2021 or 2022						26%	26%	26%	26%	26%	10%
	2023								22%	22%	22%	10%
	2024 or Later									10%	10%	10%

Acquiring or building new wind and solar projects that have higher tax credits is critical to maximizing the economic value of those projects for customers. As shown above, these tax credits can be significant, but timing is critical as projects need to be started in the near future to maximize tax credits and resulting customer savings. Therefore, selecting existing projects that are at a mature stage of development stage. In addition, matching battery storage projects with renewable projects will allow those projects to qualify for ITCs, versus standalone storage projects that will not qualify for ITCs.

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By incorporating battery storage, WEC's Generation Reshaping Plan creates a portfolio mix that can take advantage of the increasing amount of "zero cost" marginal resources in the wholesale MISO energy market. Installing battery storage, along with the construction of flexible natural gas resources, provides the opportunity to purchase from the market when prices are low, store that energy in batteries, and then sell energy into the market when prices are high. Having the appropriate resource mix for the WEC utilities' load shape will allow load to be served at a competitive cost while providing an appropriate hedge against spikes in market prices.

Portfolio – Reliability/Resiliency

In addition to economics, an optimal generation portfolio must balance other objectives to minimize customer risks. Reliability and resiliency are key aspects in the design and operation of an electric generation portfolio and have common goals:

- Keeping the power on during all hours;
- Minimizing the risk of outages;
- Withstanding disruptions and minimizing the impact of outages; and
- Quickly and efficiently restoring the system.

Reliability

The intermittent nature of renewable resources poses challenges to the overall reliability of the electric grid. As noted in NERC's 2020 Long Term Resource Assessment,

> "The addition of variable energy resources, primarily wind and solar, and the retirement of conventional generation is fundamentally changing how the bulk power system is planned and operated. The traditional methods of assessing resource adequacy at peak load times may not accurately or fully reflect the ability of the new resource mix to supply energy and reserves for all hours. Energy limitations can exist. Collectively, the new resources are more susceptible to energy sufficiency uncertainty."

As further noted by MISO in its December 2020 "Response to the Reliability Imperative," wind and solar resources are not always available to provide energy during times of need. MISO further noted that generation fleet changes and extreme weather are increasing risk across the entire year, and not just during times of peak demand in the summer. To help manage this uncertainty and risk, WEC's Generation Reshaping Plan also includes a prudent amount of dispatchable resources consisting of battery technology, and highly flexible and efficient natural gas reciprocating internal combustion engine (RICE) and combined-cycle plants.

Battery storage, although energy limited, provides capacity, ramping capability, and voltage support, enabling additional renewable resources to be integrated into the portfolio. As renewable energy resources become a larger part of the overall portfolio, the inherent variability of the energy they supply supports increased battery storage to capture excess energy and minimize the need for additional transmission resources. What is most important is to pair the right amount of variable energy supply and batteries to appropriately fit the load shape.

In addition to a "right sized" battery portfolio, combined-cycle resources, such as the Riverside Generating Station, also provide significant reliability value because of their flexibility. These resources have the ability to be quickly dispatched between minimum and maximum output, providing reliability to the grid by responding to quickly changing generation levels on the system (*e.g.* loss of wind, or at sundown).

RICE generation has even more flexibility than combined cycle technology as it is both highly flexible and scalable with individual engine models coming in 18 (or less) MW unit sizes. Individual RICE units can be cycled on and off with minimal down time and are designed to quickly scale output up or down reaching full output in 5 minutes from an off-line state. Unlike storage technologies, RICE generation is typically not fuel limited the same way renewable generation can be, and can produce energy 24 hours a day for long durations.

Together, the combination of batteries, combined cycle and RICE generation will allow larger amounts of renewable resources because of their ability to provide ramp capability necessary to reliably serve load and to offset energy production changes, either forecasted or unexpected, from renewable resources. In MISO's August 2020 "Aligning Resource Availability and Need" report, it notes a large increase in the number of grid emergencies in recent years, with the majority of these events occurring in spring, fall, and even winter months that almost never saw emergencies in the past. MISO points to multiple contributing factors for this increase, including retirement of coal units, more volatile generation forced outages and the growth of wind and solar resources that do not have the ability by themselves to generate energy in all hours. WEC's Generation Reshaping Plan is purposely designed to address and mitigate these types of grid emergencies.

Resilience

Resilience is another growing concern for the electric grid and an important consideration in developing a prudent portfolio. Resilience is related to reliability: the grid cannot be resilient if it is not first reliable. Resilience encompasses additional concepts, including preparing for, operating through, and recovering from significant disruptions, no matter what the cause. Resilience is about the ability to withstand and recover from extreme or prolonged events.

RICE generation is key to resiliency because it is capable of supporting system restoration by facilitating prompt recovery from partial or complete collapse of the electric system. Natural gas fired resources serve a key function in a balanced generation fleet and depend upon a generally reliable fuel supply, for which fuel is transported on a "just-in-time" basis.

Having a local diverse and balanced portfolio of resources with sufficient fuel assurance ensures that the electric system has adequate capacity to meet consumer needs and will be ready to respond and recover from disruptive events. WEC believes its resource mix encompassed by its Generation Reshaping Plan will provide a balanced portfolio to promote resilient, reliable operations by ensuring the local supply of essential reliability services such as capacity, ramping capability, voltage support, system inertia, and frequency response.

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Portfolio – Market Risk

WEC designed its Generation Reshaping Plan to minimize market risk, including evolving market rules, capacity price separation, and unforeseen impacts of physical changes to the electric grid. Since the first generating plants were constructed one of the most important determinations in site selection was ensuring generating facilities were located close to a utility's native load. While transmission infrastructure and electric markets have helped to broaden this view, geographic proximity of generation and load is still an extremely important risk mitigation tool. It insulates the utilities' customers from market risks due to both evolving market structure and physical changes to the electric system.

Over time, market rules, participants, utility footprints and physical characteristics within the footprint can significantly change, impacting the value proposition to customers. One example of this is the zonal capacity construct under MISO's tariff. Owning assets outside a utility's capacity zone can negatively impact the economic value of those assets due to factors outside the utility's or state's control. Ultimately geographic proximity provides a high degree of certainty that the output of these resources can be used to serve Wisconsin customers' load for a significant period of time. To manage this risk, the projects proposed in the Generation Reshaping Plan are all located within Wisconsin.

Geographic proximity is also extremely important when valuing the capacity of a generating unit, which was one of the considerations that drove development of the Generation Reshaping Plan. MISO's resource adequacy construct determines the amount of generation capacity needed to adequately serve load based on a probabilistic measure of generation availability and load levels. The generation reserve margin requirement (or simply the "reserve margin") is the amount of generation in excess of load needed to maintain a certain level of adequacy. Every year for the upcoming planning year (June 1 through May 31 of the following year), MISO calculates both a MISO-wide reserve margin and a reserve margin for zones within MISO known as Local Resource Zones (LRZ). There are ten LRZs within MISO representing boundaries where the ability to import generation over the transmission system is measured. Because the ability to import generation over the transmission system is limited, a certain amount of reserve margin is maintained within each LRZ, which is known as the Local Clearing Requirement

(LCR). The LCR ensures that each LRZ can maintain a certain level of adequacy for load within the zone without overloading the transmission system. WEC has an obligation to serve electric load in LRZ #2, which encompasses eastern Wisconsin and Michigan's Upper Peninsula, and contains the American Transmission Company's transmission system.

Every year, MISO conducts a Planning Resource Auction that sets the price of capacity to fulfil both MISO-wide and LRZ reserve margins. If there is not sufficient generation within the LRZ to fulfill the LCR, MISO sets the clearing price at the Cost of New Entry, or CONE, which has been roughly $90,000 to $100,000 per MW-year. Utilities that do not have enough generation within the LRZ are charged CONE for the amount of their load that is not covered under the LRZ reserve margin. Utilities can avoid the CONE charge by building sufficient generation within the LRZ. Historically, utilities in LRZ 2 could rely on the transmission system to import only about 1,500 – 3,000 MW of the approximately 15,000 MW reserve requirement for the zone during a generation shortage event. However, the capability of the transmission system to import power into the LRZ changes year-to-year based on several factors including the actions of third parties on neighboring systems. This introduces risk if utilities rely heavily on external resources to fulfill their reserve margin requirements.

In addition to the risk of not fulfilling the LCR, there is price separation risk if a utility utilizes an external resource to fulfil its reserve margin requirement. The Planning Resource Auction establishes a clearing price for each LRZ based on load and resources within the zone and the capability of the transmission system. Even if the LCR of an LRZ is fulfilled, a utility that utilizes a resource external to its native LRZ bears the risk that the external LRZ clears at a lower price than the native LRZ. For example, if a solar PV resource accredited at 70 MW is located in an external LRZ and clears at $5/kW but the native LRZ clears at $8/kW, the resource is paid $350 but the load pays $560, leaving a net payment by the LSE of $210. If that same resource was located in the native LRZ, the resource is paid $560 and the load pays $560, leaving the LSE a net payment of $0. The risk of Planning Resource Auction price separation between LRZs is hedged by an LSE maintaining its resource portfolio within the LRZ.

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In addition, there is great uncertainty about future market rules regarding the capacity value credited to intermittent resources, particularly solar assets. It is important to recognize that the concept of capacity value is different from the more commonly-discussed concept of a generation resource's capacity factor, which is the ratio, or percentage, of a generating resource's actual energy output over a period of time to its maximum possible energy output over that time. Accredited capacity or "capacity credit" refers to a resource's ability to meet peak load and is the amount of capacity MISO counts toward a LSE's resource adequacy requirement. A resource's capacity credit depends on its availability to provide energy when it is needed most within the MISO footprint, typically on hot summer afternoons. Because peak production from solar resources tends to correspond with these hot, sunny afternoons, solar tends to have a very high accredited capacity relative to its capacity factor.

The future of solar capacity accreditation for resource adequacy purposes remains an open issue within the MISO stakeholder forums but imminent change is not a foregone conclusion. The MISO Resource Adequacy Subcommittee management plan shows discussion of solar PV capacity accreditation starting in the third quarter of 2021. More specifically, MISO and stakeholders are expected to discuss the application of Effective Load Carrying Capability (ELCC) to solar resources. ELCC is defined as the amount of incremental load a resource can dependably and reliably serve, while also considering the probabilistic nature of generation shortfalls and time-varying electric demand. Within MISO, only the capacity credit of wind resources is determined using ELCC. The applicability of ELCC to solar resources remains an open issue because the ELCC of any resource tends to drop as more of the resource is added to the system. Effectively, the ELCC is sending a signal that other types of resources with different characteristics are needed to serve load during all hours of the year. Solar resources are very effective at serving load during the high-load levels of a hot summer day, which is why the current accreditation of solar resources considers the actual output during the summer afternoon hours. However, the ability of solar resources to serve load during the late evening hours is not very effective as solar intensity drops. As more solar resources are added to the system, a point may be reached where the ability to reliably serve late evening and nighttime loads is compromised. ELCC reflects this risk by lowering the capacity value of solar to encourage the construction of dispatchable resources such as storage and natural gas fired generation. Taken to the limit, the ELCC of wind or solar resources will approach zero because load cannot be reliably served if wind or solar make up all the resources. Simply put, there are hours when the sun is not shining and the wind is not blowing.

Several stakeholders, including WEC, have questioned the use of ELCC for solar because it is known that solar is effective at serving load on a hot sunny day. We also know that other types of resources are needed to serve load after sunset and in the winter, when the solar intensity is much lower than in the summer. While ELCC may be appropriate for wind because peak wind output is rarely coincident with peak load, applying ELCC to solar may not appropriately capture the value of solar during hot summer days. WEC has also observed that ELCC tends to penalize early adopters of a particular technology because ELCC is "averaged" across the entire fleet of resources to which it is applied.

Given this unknown risk, WEC's Generation Reshaping Plan will add a prudent amount of solar assets to its portfolio. After implementation of the Generation Reshaping Plan, WEC can then evaluate this risk as market rules evolve to ensure the lowest overall cost to fill any remaining capacity needs.

Conclusion

As detailed in the economic evaluation included in confidential appendix B, the portfolio mix contained in the Generation Reshaping Plan will allow WEC to substantially reduce carbon emissions while producing significant long term savings. The heart of the Plan is the addition of wind and solar and battery storage projects. With the loss of a significant amount of dispatchable resources, the acquisition of a portion of the Riverside combined cycle plant will minimize market risks and provide balance to WEC's portfolio. Acquiring a share of Riverside will cause no incremental environmental impacts and its age and established technology will provide benefits and security through the industry's transition to renewable energy. And, finally, the RICE units will be key to ensuring continued reliability and resiliency for the state's electric grid.

ATTACHMENT A - Supporting Need Case

As WEC continues to retire older, less efficient resources over the course of the next decades, these robust, flexible and efficient generating plants will be relied upon to manage the challenge of intermittent resources as well as provide security to the electric grid. The portfolio mix provides strong economic value, but individually each helps to manage risks to ensure customers' electric needs are prudently managed.

ATTACHMENT B – WEC Utilities' Economic Analysis

Wisconsin Electric Power Company
Docket 5-ES-111
Strategic Energy Assessment (SEA) for the Years
January 1, 2022 through December 31, 2028
Supplemental Data Request – Martin Day – 11122021

Request: Utility Resources Planning

Historically, changes in the electric portfolio were incremental, typically driven by an increase in demand for electricity. The business case was evaluated on a project-by-project basis to meet the demand, *i.e.* Project A versus Project B. However, recently the increase in demand has become relatively modest year over year as market trends and policy have increased energy efficiency and demand side management on a macro level. The business case for new generation has shifted from being primarily driven by increases in demand to being driven by the need to replace retiring older, less efficient, carbon-emitting resources. This has resulted in substantial changes across the energy industry and is causing the need to evaluate long-range decisions on a portfolio basis in order to make sound economic decisions, ensure reliability and resiliency, and ensure environmental responsibility. In evaluating the significant industry changes as well as the current state of their own portfolios, Wisconsin Electric Power Company ("WEPCO") and Wisconsin Public Service Corporation ("WPSC") (collectively "the WEC Utilities") have determined that they can deliver significant value for their customers and society by employing a holistic economic, reliability, and environmental approach to reshaping their generation portfolios.

WEC Energy Group ("WEC") has established CO_2 emission reduction goals as part of its overall environmental strategy with a 60% reduction in CO_2 emissions as compared to 2005 emission levels by 2025 and 80% reduction in CO_2 emissions by 2030. The GRP is the WEC Utilities' first step in achieving these goals and will provide the foundation for meeting the 80% reduction level by 2030. As part of the GRP the Utilities will retire approximately 1,800 MW of generation, which includes a combined 1,385 MW of older, less efficient coal generation and 190 MW of end-of-life gas generation. The energy and capacity need caused by these retirements will be met with a combination of low cost renewable technology, BESS and highly-efficient natural gas technology. The WEC Utilities have determined the best approach to meet these goals is to evaluate the overall GRP against continued operation of their respective existing generation portfolios over the study period of 30 years.

The following sections provide and identify the detailed planning assumptions and results of the WEC Utilities' economic analysis focusing on the quantifiable components of the Project as part of the GRP. The economic analysis is a comprehensive evaluation that tests and validates how the Project provides economic value as part of the WEC Utilities' overall robust GRP. In addition to the base assumptions, the economic analysis includes a sensitivity analysis, which determines how independent variables, *i.e.* planning assumptions, affect the economic value the Project provides, and in this case, how they affect the overall GRP's economic value compared to status quo.

As described in greater detail in **Section 5.0** below, the GRP, including the Project, provides a cumulative nominal savings of **$1,049 million** over the first 20 years and a combined NPV savings of **$880 million** for the WEC Utilities' customers compared to maintaining the WEC Utilities' existing generation fleet.

1.0 Generation Resource Modeling

1.1 Long-Term Capacity Expansion Model - PLEXOS

WEC utilized Energy Exemplar's ("EE") PLEXOS market simulation software ("PLEXOS") to evaluate each utility's optimal long-term expansion plan. The PLEXOS model provides the most robust model functionality and is a proven power market simulation tool that is a leader in modeling flexibility, efficiency, simulation alternatives and advanced analysis. In addition, the support, continuous improvements, and its capability to perform both fuel budget runs and capacity expansion simulations made this model the obvious choice for WEC when it came time to replace the long-term capacity expansion modeling.

PLEXOS is a comprehensive production cost model with regional databases for conducting capacity expansion planning and is used by over 280 customers with utilities being the largest customer base.[1] The model provides the capability to solve the capacity expansion problem simultaneously with commitment and dispatch. PLEXOS also accounts for all types of generation and storage resource options during generation capacity expansion. This allows PLEXOS to build balanced portfolios of conventional, renewable and storage resources, which accounts for the delivery curves of price taking wind and solar generators.

PLEXOS allows the WEC Utilities to forecast future generation portfolios and locational marginal prices across MISO; identify low cost resource options to meet the Utilities' future system needs; and simulate the dispatch, costs, and revenues of those portfolios as part of the Midcontinent Independent System Operator, Inc. ("MISO") market. Because of the robustness of the modeling capabilities

[1] Notable customers includes AEP, Xcel Energy, Dominion, Southern California Edison, MISO, PJM, and California ISO

described above, PLEXOS was chosen by the WEC Utilities as their long-term capacity expansion model to evaluate the economic value the GRP provides the WEC Utilities' customers.

1.2 Economic Modeling Approach

As described above, the economic analysis evaluates the overall GRP against continued operation of WEC Utilities' respective existing generation portfolios over the planning period, with the exception of the older gas technology for WPSC, which is described in more detail in **Section 4.2**. The WEC Utilities utilized the PLEXOS model to economically dispatch the Utilities' portfolios, optimize CO_2 emissions, and economically select new "Generic Units" to meet future capacity need in the future for both the GRP and Status Quo Alternative scenarios.

In the GRP scenario, the PLEXOS model was populated with the detailed unit characteristics and assumed in-service dates for the GRP facilities as well as the planned existing unit retirements. In the Status Quo Alternative, the GRP units are not included in the modeling run and the existing units continued to operate throughout the study period. The following provides a breakdown of how economic analysis was developed utilizing the PLEXOS model and specific internal financial calculations for each of these scenarios. A detailed breakdown of these variables is provided in the Confidential Economic Results – Base Case.

- Fuel Costs – Determined by PLEXOS
- Variable Costs – Determined by PLEXOS
- Market Energy Purchases and Sales – Determined by PLEXOS
- Avoided dispatch costs from reshaping the combined generation fleet, included as part of the impact on Fuel Costs– Determined by PLEXOS
- Market Capacity Purchases – Determined by PLEXOS
- BESS Ancillary Purchases – Internal calculation based on 3 years of historic MISO Ancillary Service Market ("ASM") data
- GRP/Status Quo Specific Unit Capital Recovery – Internal calculation using utility specific financial parameters to more accurately calculate return on and of investment and correctly incorporate investment tax credits ("ITC") and production tax credits ("PTC") when applicable
- GRP/Status Quo Specific Unit Annual Fixed Costs – Internal calculation

ATTACHMENT B – WEC Utilities' Economic Analysis

- Future Generic Unit Expansion Optimization – Determined by PLEXOS
- Generic Unit Capital Recovery/Fixed operations and maintenance ("O&M") – Fixed O&M and unit build costs were provided as inputs to the PLEXOS model based on internal calculations.

The cost information developed above was used to provide economic comparisons between the GRP and Status Quo Alternative.

2.0 Planning Assumptions

2.1 Discount Rate

The discount rate used in determining the net present value ("NPV") of the annual cost streams for the Project and the Alternatives is equal to the WEC Utilities' average weighted average cost of capital ("WACC"). The WACC used in the evaluation for WPS is 7.22% and is 7.49% for WEPCO. The NPV values in the economic evaluation are expressed in 2021 dollars.

2.2 Study Period

The study period focuses on a 30-year time period from 2021 to 2050, which lines up with the PLEXOS capacity expansion model. However, the economic model also includes a 10-year extension period to allow capital investments and their corresponding revenue requirements unwind, which equates to a total 40-year study period. All other costs in the 10-year extension period escalate at the defined escalation rate described in **Section 2.3**.

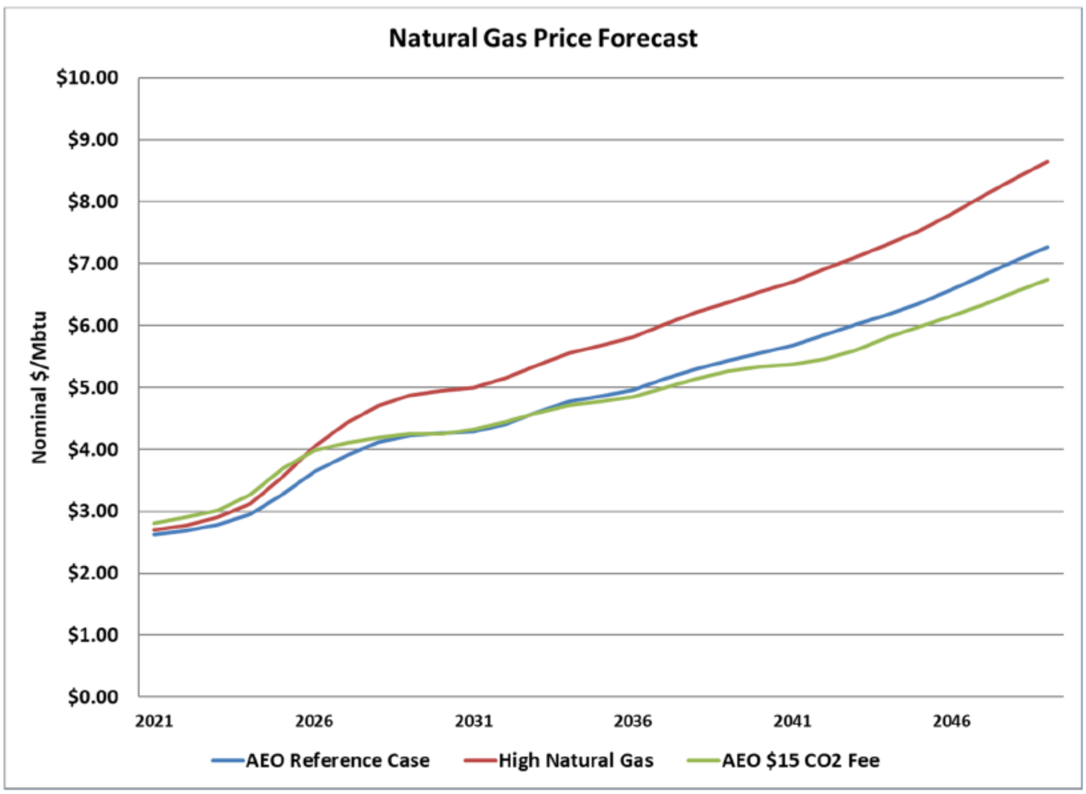
2.3 Escalation Rate

The base escalation rate assumption utilized in the economic analysis to account for increases in costs due to nominal and real inflation was 2.5%. This rate was applied to fixed and variable O&M, market capacity prices, CO_2 monetization costs, arbitrage value (BESS), and coal prices. Additional sensitivities were performed on this variable and are described below.

2.4 Natural Gas Price Forecast

The base natural gas price forecast used in the economic evaluation was developed and provided in EIA's 2020 Annual Energy Outlook ("AEO") – Reference Case. Two natural gas price sensitivities were performed to test the overall impact natural gas prices would have on the overall economics of the GRP. A high natural gas price forecast was developed by calculating and adding one standard deviation to the Reference Case forecast. The other forecast was based on AEO's assumption of a $15 Carbon Dioxide Allowance Fee scenario, which included a CO_2 tax on every ton of CO_2 produced. This gas price forecast reflects AEO's assumption that such a tax would be implemented and was included as a sensitivity to the base assumptions, which do not include a CO_2 tax but rather a proxy for the avoided cost to customers by transitioning the combined fleet to meet carbon reduction goals as described further in **Section 2.10**. These natural gas prices were then used to develop the market price forecasts for MISO's LRZ2 area that was used in the capacity expansion model. **Figure 2-1** below includes the natural gas price forecast assumptions used in the evaluation.

Figure 2-1

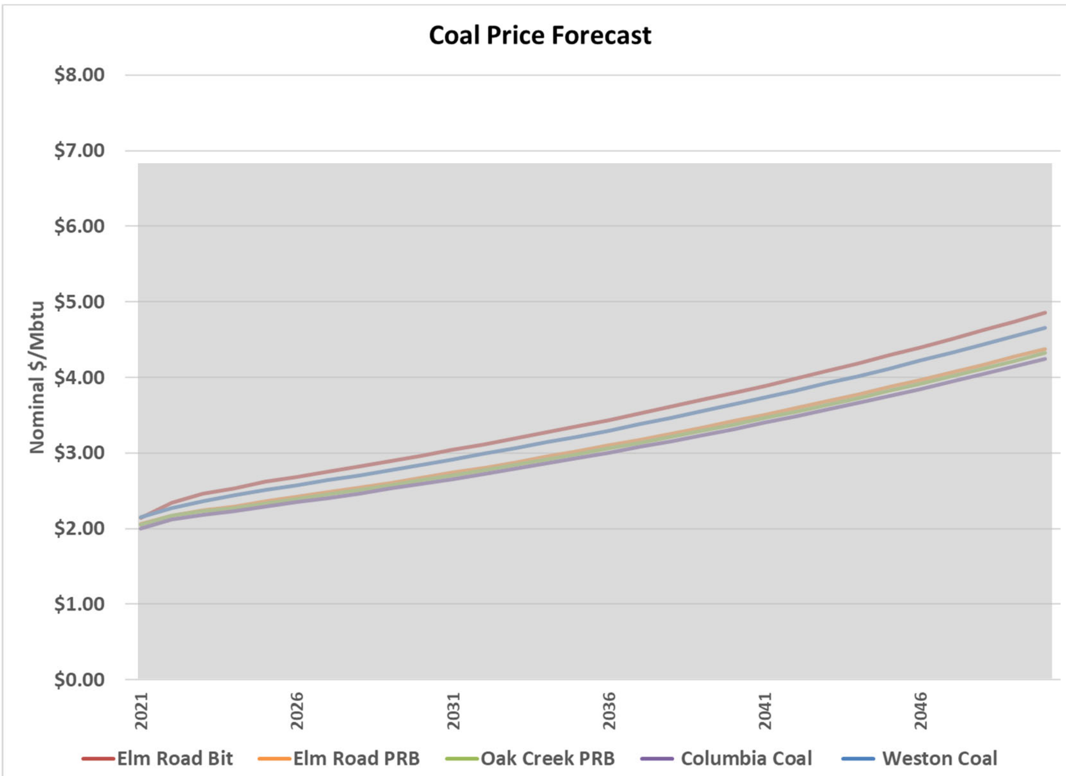


2.5 Coal Price Forecast

ATTACHMENT B – WEC Utilities' Economic Analysis

The coal price forecasts for each of the WEC Utilities' coal plants are based on the most recent internal forecasts. After the forecasted time period the coal prices are escalated 2.5% annually over the balance of the study period. **Figure 2-2** below includes the base coal price forecast used in the economic evaluation.

Figure 2-2



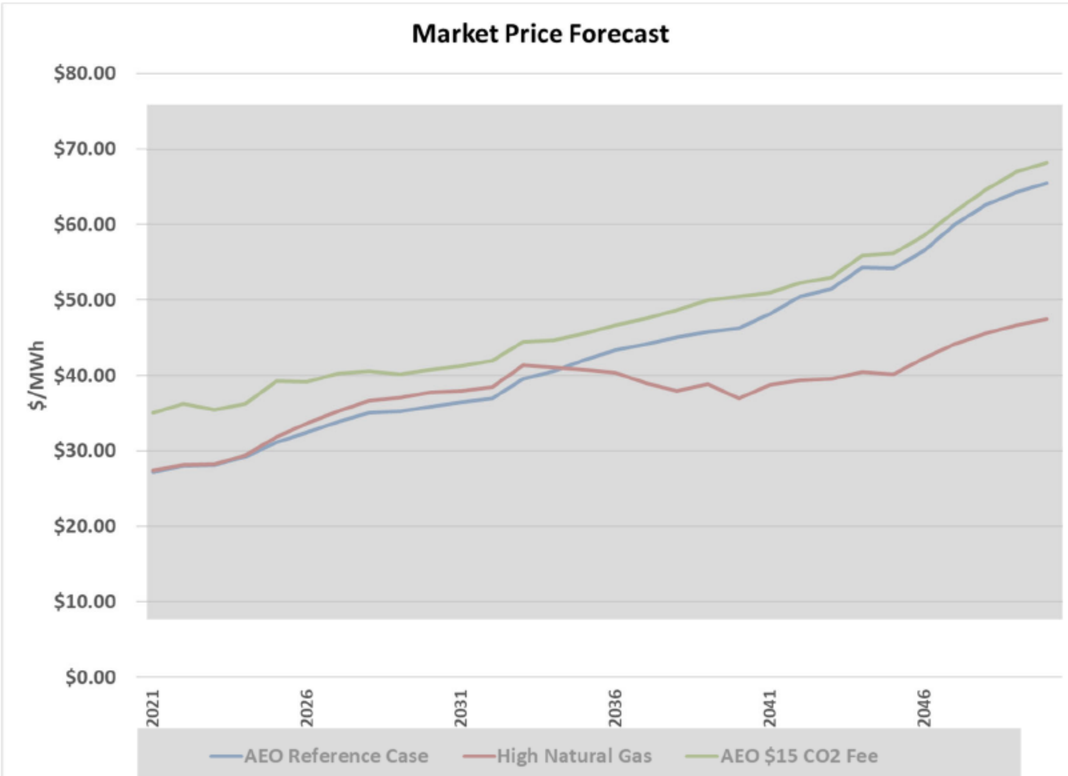
2.6 Market Energy Prices

As part of the overall process, the WEC Utilities contracted with Energy Exemplar and Siemens to model long-term expansion and the resulting market prices of the Eastern Interconnect and specifically MISO Load Resource Zone 2 ("LRZ2")[2]. Market price forecasts generated were then incorporated into PLEXOS to appropriately represent the market while optimizing each individual utility's integrated resource plan for 2021-2050. **Figure 2-3** shows the electricity market price forecast based on the natural gas price forecasts utilized in the evaluation.

[2] Energy Exemplar's Aurora model was used to produce the market prices for the Eastern Interconnect and MISO LRZ2.

ATTACHMENT B – WEC Utilities' Economic Analysis

Figure 2-3



2.7 Demand and Energy Forecast

The annual peak demand and energy forecasts are provided in **Table 2-1** for both utilities.

Table 2-1: Demand and Energy Forecasts

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WEPCO											
Energy	MWh	[redacted]									
Peak Demand (MISO Coincident)	MW										
WPS											
Energy	MWh										
Peak Demand (MISO Coincident)	MW										

** Assumes wholesale contracts are not renewed upon expiration and load remains flat after 2030*

2.8 Market Energy CO2 Content

The average CO_2 content per MWh used in the evaluation assumes 1,000 lb/MWh as a starting point. The Utilities looked at the average CO_2content of overall generation in the Eastern Interconnect in the long-term market runs and applied the annual ratio decrease in CO_2 content observed from those results to the 1,000 lb/MWh. For example, the CO_2 content for market energy assumption is 1,000 lb /MWh in 2025, and reduces to 931 lb/MWh by 2030 and 866 lb/MWh by 2040.

2.9 Avoided dispatch costs from reshaping the combined generation fleet

The economic evaluation includes, as a part of the impact on fuel costs, an evaluation of avoided dispatch costs to customers by transitioning the combined fleet to meet carbon reduction goals when compared to operating the existing fleet into the future. To accomplish this objective, a proxy value of the of the cost of carbon was used in the analysis but is not considered a CO_2 tax. The base assumption for this proxy value is $20/ton of carbon emitted starting in 2025, which is the year of the first CO_2 reduction target. This proxy value escalates 2.5% per year over the balance of the study period. Sensitivities around this proxy value were performed to test the robustness and impact it has on the GRP's overall economic benefit.

PLEXOS has the ability to optimize dispatch in order to meet CO_2 reduction level targets at the lowest system cost. Within the PLEXOS model, constraints are applied that optimize the combination of unit-generated CO_2 emissions and market-purchased energy CO_2 emissions. Market purchased energy is assigned a CO_2 rate as described in **Section 2.9**. Within the model, the total CO_2 output is calculated as a combination of each utility's unit-specific output and net purchases. PLEXOS then solves to meet the specified CO_2 reduction goals shown in **Section 2.8** with a balanced approach to self-generation or market energy purchases but with a soft limit on the CO_2 reduction limits. The model has the option to utilize a market price bid adder ($20/ton), equivalent to a CO_2 offset – as a proxy value - for CO_2 emissions above the specified limits if it is economic to do so versus building additional generation to meet those goals. The proxy value of $20/ton of emitted carbon is based on Lazard's 2021 Levelized Cost of Energy Analysis (v14.0) carbon pricing range of $20 - $40/ton of carbon.

Unlike the base assumption of a CO_2 off-set cost, one of the gas price sensitivities included a $15/ton CO_2 tax which is applied to every ton of CO_2 produced, as described in **Section 2.4**, and therefore did not include the baseline $20/ton CO_2 off-set cost described above.

2.10 Market Capacity Price Forecast

Cost of New Entry (CONE) is the standard long-term price of capacity in resource planning. The reason for this assumption is that over time, any current excess capacity in the system will be utilized or removed (retirements or economic shutdown) and as such, the cost of any newly needed capacity will be the cost of building a unit. The most recent value of CONE in our area, MISO LRZ 2, is \$90,940/MW-yr[3]. This long-term cost planning assumption is understandably too high to be utilized in the immediate future so the assumption is gradually increase up the value of CONE. This means that 2021 is evaluated at 25% of CONE, 2022 at 50%, 2023 at 75%, and all years after 2024 are evaluated at the full value of CONE with annual escalation

2.11 Generic Units

Generic units are utilized in the capacity expansion model to optimize the balance of the Utilities' portfolio with future decisions on additional generation when there is a capacity need in the future. Both of the WEC Utilities forecast modest load growth from 2021 to 2030 and then flat demand for the balance of the study period. Load growth is not a significant driver of capacity need. After the retirement of the older coal and gas units identified in this analysis, capacity need is primarily driven by expiration of existing PPAs, namely the Point Beach PPA.

The generic units that were modeled in PLEXOS to meet future capacity needs after 2025 are provided below in **Table 2-3**. In addition to the generic units identified below, the model also has the option to select market capacity as a capacity source, up to 300 MW, to meet capacity need and priced at CONE.

Table 2-3: Generic Units

Generic Expansion Unit Parameters:	Capacity	ICAP Value	Capacity Factor	Forced Outage	Annual Maint.	Heat Rate	Capital Cost	Fixed O&M	[redacted]	Battery Repower	Variable O&M
	MW	%	%	%	Weeks/Yr	btu/kWh	\$/kW	\$/kW-yr		\$/kW-yr	\$/MWh
Solar	[redacted]										
Wind											
Combined Cycle											
Combustion Turbine											
RICE											
Battery Storage											
Solar "Plus" Battery Storage											
Wind "Plus" Battery Storage											

[3] Sourced from MISO Annual CONE Filing: https://cdn.misoenergy.org/Final%20Annual%20CONE%20Filing%20(2020)480413.pdf

ATTACHMENT B – WEC Utilities' Economic Analysis

3.0 Generation Reshaping Plan

The WEC Utilities expect to retire approximately 1,800 MW of fossil-fueled generation by 2025.[4] The overall GRP is to replace a portion of the retired capacity by building and owning a combination of clean, natural gas-fired generation and zero-carbon-emitting renewable generation facilities. **Table 3-1** provides a summary of the technology parameters and costs in the GRP for both WEPCO and WPSC.

[redacted]

ATTACHMENT B – WEC Utilities' Economic Analysis

Table 3-1: GRP Parameters

TECHNOLOGY	UTILITY	CAPACITY		IN-SERVICE	CAPITAL COST	
		ICAP	UCAP		$MM	$/kW
SOLAR	WEPCO	788	551	2023/2024	1,091	1,385
	WPS	158	110	2023/2024	218	1,385
BESS	WEPCO	451	442	2023/2024	631	1,399
	WPS	107	105	2023/2024	146	1,357
WIND	WEPCO	n/a	n/a	n/a	n/a	n/a
	WPS	82	13	2022	146	1,774
GAS (RICE)	WEPCO	64	61	2023	86	1,339
	WPS	64	61	2023	86	1,339
GAS (RIVERSIDE)	WEPCO	200	190	2023/2024	182	910
	WPS	n/a	n/a	n/a	n/a	n/a
TOTAL	**WEPCO**	**1,503**	**1,244**	**2023/2024**	**1,990**	**1,324**
	WPS	**411**	**289**	**2022/2024**	**596**	**1,449**
	COMBINED	**1,914**	**1,533**	**2023/2024**	**2,585**	**1,351**

4.0 Status Quo Alternative

The Alternative included in the economic evaluation is a continuation of the WEC Utilities' existing portfolios, with one small exception for WPS. Estimates for continued fixed O&M, capital expenditures, and capital overhauls were considered and included for continued operation of WEPCO's Oak Creek Coal Facility (Units 5-8) and WPS's ownership share of the Columbia Coal Facility (Units 1-2).

4.1 WEPCO

The Status Quo for WEPCO includes continued operation of Oak Creek Units 5-8 (1,075 MW) through the 30-year study period and a 10-year extension of the PPA for the Whitewater Combined Cycle unit (238 MW).

Continued long-term operation the Oak Creek units for another 30 years would require the remainder of the plant projects identified in a 2014 analysis performed by an external consultant HDR to determine a long-term capital spending plan. This effort defined the costs and benefits of potential plant projects aimed at improving Oak Creek Units 5-8 reliability, maintenance and safety to allow for increased plant availability and dispatch. A limited number of these projects were completed in the subsequent years as part of a major plant renovation. In order to operate for another 30 years, the remainder of the plant projects identified in this report would be required. The total cost to complete this major plant renovation is estimated at $200 million. In addition to the capital cost for major renovation, plant fixed O&M and capital maintenance costs are modeled to continue at current levels, with escalation applied. O&M costs are estimated at $47.5 million per year and capital maintenance costs are estimated at $10 million per year for the entire facility, which is equivalent to $2.5 million per year for each unit.

The average annual modeled cost of the Whitewater PPA extension is approximately $27.5 million per year. This includes a continuation of the lease payment and firm pipeline costs. The capacity payment portion of the PPA is modeled at ½ the value of CONE and remains flat over the 10-year extension.

4.2 WPS

As previously mentioned WPS is planning on retiring some of its old, less efficient gas technology. These units include Weston 2 (steam unit), Weston 31 and 32 (aero derivative combustion turbines), and Marinette 31 and 32 (aero derivative combustion turbines). These units have been providing utility service to customers for nearly a half century and have reached the end of their useful life. Due to obsolescence of parts and services, less robust aftermarket on non-OEM support, longer lead times for replacement parts, and less predictability of sustaining O&M and capital costs these units are not considered for continued operation in the Status Quo Alternative. As a replacement to the retirement of these units and to reflect the need to have generation at or near the Weston facility to provide transmission support, a 3-unit RICE facility is included in the Status Quo Alternative.

Similar to the continued operation of the Oak Creek units for WEPCO, additional capital would be required to renovate/overhaul Columbia Units 1 and 2 in order to continue operation for the next 30 years. WPS's ownership share of the estimated capital cost for overhaul is $24 million for both units and O&M costs are estimated at $13.5 million per year and capital maintenance costs are estimated at $5.5 million per year for both units.

5.0 Economic Evaluation

WEC undertook a robust evaluation of the quantitative benefits the GRP provides the WEC Utilities' customers. As part of the evaluation it is important to test primary assumptions to understand the overall impact it has on the results. This type of evaluation determines how different values of an independent variable, *i.e.* planning assumptions, affect the economic value a project – or, in this case, an interrelated series of projects -- provides compared to alternatives. The planning assumptions identified and incorporated in the sensitivity analysis are as follows and shown in **Figure 5-1**:

- Gas price forecast
- Avoided dispatch costs from reshaping the combined generation fleet
- CO_2 content for market energy purchases
- Must run status on Oak Creek and Columbia Units
- Escalation rate
- BESS ancillary revenue estimates in the GRP
- Fixed O&M estimates in the GRP

Figure 5-1: Sensitivity Assumptions

Comparison Case	Scenario		Gas Price Forecast			CO2 Monetization Price				Market CO2 Content		Coal Must Run Months		Escalation Rate			GRP BESS Ancillary		GRP Fixed O&M Costs		
	GRP	Status Quo	Base	High	$15/ton CO2 tax	$20	$10	$30	$15 (tax)	[redacted]		Annual	Summer/ Winter	[redacted]			Base	Minus 50%	Base	Plus 25%	Minus 25%
Base Case	x		x			x				x		x		x			x		x		
		x	x			x				x		x		x			x		x		
Sensitivity 1	x		x				x			x		x		x			x		x		
		x	x				x			x		x		x			x		x		
Sensitivity 2	x		x					x		x		x		x			x		x		
		x	x					x		x		x		x			x		x		
Sensitivity 3	x		x			x					x	x		x			x		x		
		x	x			x					x	x		x			x		x		
Sensitivity 4	x		x			x				x			x	x			x		x		
		x	x			x				x			x	x			x		x		
Sensitivity 5	x		x			x				x		x			x		x		x		
		x	x			x				x		x			x		x		x		
Sensitivity 6	x		x			x				x		x				x	x		x		
		x	x			x				x		x				x	x		x		
Sensitivity 7	x			x		x				x		x		x			x		x		
		x		x		x				x		x		x			x		x		
Sensitivity 8	x				x				x	x		x		x			x		x		
		x			x				x	x		x		x			x		x		
Sensitivity 9	x		x			x				x		x		x				x	x		
		x	x			x				x		x		x				x	x		
Sensitivity 10	x		x			x				x		x		x			x			x	
		x	x			x				x		x		x			x			x	
Sensitivity 11	x		x			x				x		x		x			x				x
		x	x			x				x		x		x			x				x

Using the base planning assumptions described in detail above, the GRP provides a cumulative nominal savings of **$1,049 million** over the first 20 years and a combined NPV savings of **$880 million** for the WEC Utilities' customers compared to the Status Quo Alternative. Investing in renewable energy technology provides significant energy savings over their useful life compared to traditional fossil-fueled generation but also can mean a significant capital investment to realize those

ATTACHMENT B – WEC Utilities' Economic Analysis

savings. That is very much evident in the results of the analysis. Breaking the $880 million NPV savings into two components illustrates this relationship. The combined fuel, fixed and variable O&M, market capacity and net energy purchases, CO_2 monetization and ancillary service NPV savings for both utilities is $1,933 million whereas the capital recovery NPV savings is a negative $1,053 million (increase in overall cost) compared to the Status Quo Alternative.

The sensitivity analysis indicates the value the GRP provides over a wide range of planning assumptions with a minimum combined NPV savings of **$477 million** and a maximum combined NPV savings of **$1,183 million**.

A breakdown of the results of the economic analysis for WPSC and WEPCO are provided in the **Figures 5-2 and 5-3**, and the combined results are provided in **Figure 5-4**. Savings to the customer are shown as negative values in the tables.

Figure 5-2: WPSC Results

Net Benefits: GRP Cost/(Saving) Compared to Status Quo

Case ID	*Description*	WPSC		
		20-Year Nominal $MM	*30-Year Nominal $MM*	*Life Cycle NPV $MM*
Base Case	**Base Assumptions**	**(361)**	**(957)**	**(311)**
Sensitivity 1	*$10/ton proxy value for cost of CO2*	*(143)*	*(536)*	***(163)***
Sensitivity 2	*$30/ton proxy value for cost of CO2*	*(544)*	*(1,319)*	***(436)***
Sensitivity 3	[redacted] *CO2 content for market purchases*	*(327)*	*(932)*	***(291)***
Sensitivity 4	*Oak Creek/Columbia must run summer/winter only*	*(263)*	*(791)*	***(249)***
Sensitivity 5	[redacted] *escalation rate*	*(296)*	*(765)*	***(249)***
Sensitivity 6	[redacted] *escalation rate*	*(427)*	*(1,158)*	***(377)***
Sensitivity 7	*High natural gas price forecast**	*(345)*	*(960)*	***(311)***
Sensitivity 8	*$15/ton CO2 tax & gas price forecast**	*(285)*	*(826)*	***(265)***
Sensitivity 9	*GRP ancillary revenues minus 50%*	*(332)*	*(902)*	***(292)***
Sensitivity 10	*GRP Fixed O&M costs minus 25%*	*(402)*	*(1,031)*	***(338)***
Sensitivity 11	*GRP Fixed O&M costs plus 25%*	*(320)*	*(882)*	***(284)***

Combined metrics from above cases:

Minimum Savings	***(143)***	***(536)***	***(163)***
Average Savings	**(337)**	**(922)**	**(297)**
Maximum Savings	***(544)***	***(1,319)***	***(436)***

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Figure 5.3: WEPCO Results

Net Benefits: GRP Cost/(Saving) Compared to Status Quo

Case ID	*Description*	WEPCO *20-Year Nominal $MM*	WEPCO *30-Year Nominal $MM*	WEPCO *Life Cycle NPV $MM*
Base Case	**Base Assumptions**	**(688)**	**(2,497)**	**(569)**
Sensitivity 1	*$10/ton proxy value for cost of CO2*	*(158)*	*(1,681)*	***(314)***
Sensitivity 2	*$30/ton proxy value for cost of CO2*	*(967)*	*(3,094)*	***(747)***
Sensitivity 3	[redacted] *CO2 content for market purchases*	*(716)*	*(2,575)*	***(591)***
Sensitivity 4	*Oak Creek/Columbia must run summer/winter only*	*(417)*	*(1,935)*	***(396)***
Sensitivity 5	[redacted] *escalation rate*	*(448)*	*(1,902)*	***(380)***
Sensitivity 6	[redacted] *escalation rate*	*(900)*	*(3,264)*	***(782)***
Sensitivity 7	*High natural gas price forecast**	*(644)*	*(2,600)*	***(583)***
Sensitivity 8	*$15/ton CO2 tax & gas price forecast**	*(754)*	*(2,579)*	***(609)***
Sensitivity 9	*GRP ancillary revenues minus 50%*	*(568)*	*(2,270)*	***(492)***
Sensitivity 10	*GRP Fixed O&M costs minus 25%*	*(825)*	*(2,744)*	***(655)***
Sensitivity 11	*GRP Fixed O&M costs plus 25%*	*(551)*	*(2,250)*	***(484)***

Combined metrics from above cases:

Minimum Savings	***(158)***	***(1,681)***	***(314)***
Average Savings	**(636)**	**(2,449)**	**(550)**
Maximum Savings	***(967)***	***(3,264)***	***(782)***

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Figure 5-4: Combined WPSC/WEPCO Results

Net Benefits: GRP Cost/(Saving) Compared to Status Quo

Case ID	*Description*	WPSC/WEPCO Combined *20-Year Nominal $MM*	*30-Year Nominal $MM*	*Life Cycle NPV $MM*
Base Case	**Base Assumptions**	**(1,049)**	**(3,454)**	**(880)**
Sensitivity 1	*$10/ton proxy value for cost of CO2*	*(301)*	*(2,217)*	***(477)***
Sensitivity 2	*$30/ton proxy value for cost of CO2*	*(1,511)*	*(4,413)*	***(1,183)***
Sensitivity 3	[redacted] *CO2 content for market purchases*	*(1,043)*	*(3,506)*	***(881)***
Sensitivity 4	*Oak Creek/Columbia must run summer/winter only*	*(681)*	*(2,725)*	***(645)***
Sensitivity 5	[redacted] *escalation rate*	*(744)*	*(2,667)*	***(629)***
Sensitivity 6	[redacted] *escalation rate*	*(1,328)*	*(4,422)*	***(1,159)***
Sensitivity 7	*High natural gas price forecast**	*(989)*	*(3,561)*	***(894)***
Sensitivity 8	*$15/ton CO2 tax & gas price forecast**	*(1,039)*	*(3,406)*	***(874)***
Sensitivity 9	*GRP ancillary revenues minus 50%*	*(899)*	*(3,172)*	***(784)***
Sensitivity 10	*GRP Fixed O&M costs minus 25%*	*(1,227)*	*(3,775)*	***(992)***
Sensitivity 11	*GRP Fixed O&M costs plus 25%*	*(871)*	*(3,132)*	***(768)***

Combined metrics from above cases:

Minimum Savings	***(301)***	***(2,217)***	***(477)***
Average Savings	**(973)**	**(3,371)**	**(847)**
Maximum Savings	***(1,511)***	***(4,422)***	***(1,183)***

5.1 CO_2 Goals

Using the base planning assumptions described in detail above the GRP Plan enables WEC to be in a position to meet its 2025 CO_2 emission goals as stated in Table 2-2 above. Investing in renewable energy technology provides significant reduction in CO_2 emissions compared to traditional fossil-fueled generation and is very much evident in the results of the analysis.

A visual of the results of the carbon reduction for combined WEPCO and WPSC are provided in **Figure 5-5**.

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Figure 5-5